Distributed lossless compression has a beautiful solution given by the Slepian-Wolf theorem, showing there is essentially no loss due to the distributed nature of the problem. The lossy case is often harder, with solutions known for some cases, others being still open. However, in many problems of distributed signal compression, the data is not arbitrary. Thus, we look at the problem by going back to the physical set-up that generates the distributed data to be compressed. The exemplary case is the wave equation, and distributed acoustic signals. In prior work, we studied the Green's function of the acoustic wave equation, and shown an array sampling theorem. In the current work, we build on this result to derive a scheme for distributed compression that reaches the optimal, centralized rate-distortion function. The method uses sampling on a non-separable lattice to equalize the spectrum, and this whitened spectrum leads to iid samples in time and space that can be optimally compressed in a decentralized way. We also discuss other cases of distributed signals, their generating processes, and the implication for distributed compression.